ADAPTIVE ENERGY ABSORBING SYSTEM USING PIN PULLERS

FIELD OF THE INVENTION

[0001] The invention relates to an energy absorber and more particularly to an energy absorbing apparatus for absorbing energy at different rates.

BACKGROUND OF THE INVENTION

[0002] Steering column assemblies for vehicles often include kinetic energy absorption devices that act to control the collapse of the column in the event of a crash to reduce the likelihood of injury to the driver. One form of an energy absorbing device comprises a metal strap that is bent and drawn over an anvil to absorb kinetic energy of a collapsing column. Examples of this type of energy absorbing device include U.S. Patent Nos. 6,170,874; 6,189,929; 6,322,103; and 6,652,002.

SUMMARY OF THE INVENTION AND ADVANTAGES

[0003] The invention provides an apparatus for absorbing energy in a collapsible steering column of a vehicle. A portion of the apparatus is deformable in response to an excessive frontal impacting force to the steering column so that injury to the vehicle operator is reduced. The apparatus includes a first steering column member and a second steering column member connected to one another such that the first steering column member slides relative to the second steering column member. The apparatus also includes a first anvil associated with a said first steering column member and a second anvil associated with said second steering column member. The apparatus also includes an energy absorbing member having a first portion extending around and operable to be drawn over said first anvil and a second portion extending around and operable to be drawn over said second anvil.

[0004] The present invention provides the advantage of broadening the spectrum of accident parameters that may be used to improve the crashworthiness response of an energy-absorbing column. Furthermore, the invention provides a structure that has heretofore been impossible to use to vary the amount of resistance force to various inputs. The structure to vary the resistance force is an enhancement to the performance of the deformable member. The enhancement, for example, can provide a smaller amount of

resistance in the case of a less severe collision or a lower weight occupant and a greater amount of resistance in the case of a more severe collision of a larger weight occupant.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0006] Figure 1 is a perspective view of a first exemplary embodiment of the invention;

[0007] Figure 2 is a side, cross-sectional view of the first exemplary embodiment of the invention positioned in a steering column as a relatively low impacting force is applied to the steering column;

[0008] Figure 3 is a side, cross-sectional view of the first exemplary embodiment disposed in the steering column after the relatively low impacting force has been applied to the steering column;

[0009] Figure 4 is a side, cross-sectional view of the first exemplary embodiment disposed in the steering column as a relatively high impacting force is applied to the steering column;

[0010] Figure 5 is a side, cross-sectional view of the first exemplary embodiment disposed in the steering column after the relatively high impacting force has been applied to a steering column;

[0011] Figure 6 is a side, cross-sectional view of a second exemplary embodiment of the invention; and

[0012] Figure 7 is a top view of the second exemplary embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Referring now to Figures 1-5, the invention provides an apparatus 10 for absorbing energy in a collapsable steering column 12 of a vehicle. A portion of the apparatus 10 is deformable in response to an excessive frontal impacting force 14 to the steering column 12 so that injury to the vehicle operator is reduced. The apparatus 10 includes a first steering column member 16 and a second steering column member 18.

One of the first and second steering column members 16, 18 is fixedly connected to the vehicle and the other is movably associated with the vehicle.

[0014] The first and second steering column members 16, 18 are connected to one another for sliding movement 20. In the exemplary embodiment of the invention, the second steering column member 18, is fixedly connected to the vehicle and the first steering column member 16 is slidably associated with the second steering column member 18 to move in the direction of sliding movement 20 in an impact situation.

[0015] The apparatus 10 also includes a first anvil 22 associated with the first steering column member 16 and a second anvil 24 associated with the second steering column member 18. The apparatus also includes an energy absorbing member 26 having a first portion 28 extending around an operable to be drawn over the first anvil 22. The energy absorbing member 26 also includes a second portion 30 extending around an operable to be drawn over the second anvil 24.

[0016] In operation, one of the first and second portions 28, 30 is drawn over the corresponding anvil 22, 24 in response to the severity or level of the frontal impacting force 14. For example, in the exemplary embodiment of the invention, a greater amount of energy dissipated when the second portion 30 of the energy absorbing member 26 is drawn over the second anvil 24 with respect to the amount of energy dissipated when the first portion 28 is drawn over the first anvil 22. If the level of frontal impacting force 14 is relatively high, the apparatus 10 responds by drawing the second portion 30 of the energy absorbing member 26 over the second anvil 24. Similarly, if the level of frontal impacting force 14 is relatively low, the apparatus 10 responds by drawing the first portion 28 of the energy absorbing member 26 over the first anvil 22.

[0017] The apparatus 10 also includes a locking device 32 associated with the energy absorbing member 26 to lock one of the first and second portions 28, 30 relative to the respective anvil 22, 24 in order to enhance the absorption of energy. In particular, as set forth above, the locking device 32 locks one of the first and second portions 28, 30 so that the energy absorbing member 26 absorbs energy at a desired rate. For example, if the locking device 32 is not engaged, the portion 28, 30 of the energy absorbing member 26 that dissipates less energy will be drawn over the corresponding anvil 22, 24 in response to the frontal impacting force 14 acting on the steering column 12. In other words, the energy absorbing member 26 will follow the path of least resistance. In the exemplary

embodiment of the invention, the locking device 32 locks the first portion 28 relative to the first anvil 22 so that the higher rate of energy absorption associated with drawing the second portion 30 over the second anvil 24 is achieved.

[0018] The locking device 32 is responsive to a controller 48 that communicates with sensors (not shown). The sensors sense the severity of the frontal impacting force 14 and communicate sensed conditions to the controller 48. In response to the sensed conditions, the controller 48 selectively activates the locking device 32. The locking device 32 can be activated in response to a relatively high frontal impacting force 114 or can remain disengaged in response to a relatively low frontal impacting force 14. Also, the locking device 32 can be engaged after a predetermined length of the first portion 28 has been drawn over the first anvil 22 or immediately upon the application of the frontal impacting force 114 to the steering column 12.

[0019] In the first exemplary embodiment of the invention, the first anvil 22 is supported by a pin 50 that is releasably associated with the first steering column member 16. The locking device 32 includes a releasing device 38 operable to separate the anvil 22 from the steering column member 16. The releasing device 38 includes a pyrotechnic charge 40. When the pyrotechnic charge 24 is fired by the controller 48, the pin 50 is retracted from an interior aperture defined by the anvil 22.

[0020] The locking device 32 also includes a first surface 34 and a second surface 36 movably positioned with respect to one another. In the exemplary embodiment, the second surface 36 is defined by the anvil 22. The energy absorbing member 26 extends between the first and second surfaces 34, 36 and is selectively compressible between the first and second surfaces 34, 36. After the releasing device 38 fires the pyrotechnic charge 24 to retract the pin 50 and release the anvil 22, the energy absorbing member 26 moves the anvil 22, and the second surface 36, closer to the first surface 34 in response to the sliding movement 20 between the first and second steering column members 16, 18. Furthermore, the energy absorbing member 26 will be compressed between the first and second surfaces 34, 36 as the first and second surfaces 34, 36 are moved closer to one another in response to the sliding movement 20. The energy absorbing member 26 is compressed between the first and second surfaces 34, 36, increasing frictional resistance to movement of the first portion 28 of the energy absorbing member 26 relative to the first anvil 22.

[0021] The locking device 32 of the apparatus 10 also includes a third surface 42 fixedly spaced from the first surface 34. The third surface 42 is movably positioned with respect to the second surface 36. The energy absorbing member 26 extends between the third surface 42 and the second surface 36 so that the energy absorbing member 26 is selectively compressible between the third surface 42 and the second surface 36, similar to the compressive cooperation between the first and second surfaces 34, 36. Frictional resistance to movement is generated when the energy absorbing member 26 is compressed between the third surface 42 and the second surface 36 after the pin 50 is released by the releasing device 38. The third surface 42 and the first surface 34 spaced a first distance from one another such that the anvil 22 is wider than the first distance.

[0022] Differentiation of the energy absorbing characteristics associated with drawing the first portion 28 over the first anvil 22 and associated with drawing the second portion 30 over the second anvil 24 can be achieved by forming the first and second portions 28, 30 differently with respect to one another. For example, the first and second portions 28, 30 can have different widths. Also, the first and second portions 28, 30 can have different thicknesses. Alternatively, the first and second anvils 22, 24 can be configured differently with respect to one another to differentiate the energy absorbing characteristics. For example, one of the first and second anvils 22, 24 can define an outer surface having a greater radius than a surface defined by the other of the first and second anvils 22, 24.

[0023] Referring now to Figures 6 and 7, an apparatus 110 according to a second exemplary embodiment of the invention includes a first steering column member 116 and a second steering column member 118 connected together for sliding movement 120. The first steering column member of the second exmeplary embodiment is a bracket and second steering column member 118 is a capsule. The apparatus 110 also includes a first anvil 122 associated with the first steering column member 116 and a second anvil 124 associated with the second steering column member 118. An energy absorbing member 126 includes a first portion 128 extending around an operable to be drawn over the first anvil 122 and also includes a second portion 130 extending around an operable to be drawn over the second anvil 124. The energy absorbing member 126 absorbs energy at a first rate as the first portion 128 is drawn over the first anvil 122 and absorbs energy at a second rate as the second portion 130 is drawn over the second anvil 124. The first rate is

lower than the second rate because the first anvil 122 defines a greater radius than the second anvil 124.

[0024] A locking device 132 is associated with the energy absorbing member 126 to lock the first portion 128 relative to the first anvil 122. The locking device 132 includes an aperture 44 defined by the energy absorbing member 126. The locking device 132 also includes a pin 46 insertable in the aperture 44. The apparatus 110 is biased in a locked position. In other words, the locking device 132 is engaged prior to the application of an impacting force to the steering column and the second portion 130 will be drawn over the second anvil 124 in response to the sliding movement 120.

[0025] A controller 148 communicates with sensors (not shown) that can sense the application and severity of an impacting force. In response to sensed conditions, the controller 148 controls a releasing device 138 to move the pin 46 from engagement with the aperture 44. In response to the retraction of the pin 46 from the aperture 44, the first portion 128 of the energy absorbing member 126 will be drawn over the first anvil 122.

[0026] While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.